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ABSTRACT

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MEASURING COMPONENTS OF CHILDREN'S HEALTH STATUS

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ABSTRACT

Measures of physical, mental, and social components of health status and general health ratings were studied for children ages 0-4 (N=679) and 5-13 (N=1473). Questionnaires were completed by adult proxies (usually mothers) in three generally healthy populations. Hypothesized multi-item scales were tested; reliability was estimated and preliminary attempts at validation were undertaken.

Items in ten scales pertaining to mental health (anxiety, depression, positive well-being, mental health index), social health (social relations), general health ratings (current health, prior health, resistance/susceptibility to illness, general health rating index), as well as parental satisfaction with child development satisfied Likert-type and discriminant validity criteria. Because functional limitation items were endorsed for very few children, scales to measure physical health could not be tested. Almost all other scales were sufficiently reliable for group comparisons; reliability coefficients were lower in the most disadvantaged population. Interrelationships among scales and validity variables generally supported their construct validity and supported a multi-component model of children's health status.

A major purpose of medical care in developed countries is to maintain or improve the health of children. Policymakers presumably could make better decisions regarding how medical care should be altered to achieve this goal if data describing the impact of various policies on the health status of children were available. The need for such indexes became critical when the Health Insurance Study (HIS) was being designed (10). The HIS is a social experiment conducted in six sites across the United States. It is designed to test the effects of different health care financing arrangements (differing coinsurance and deductible rates and fee-for-service practice versus prepaid group practice) on the use of personal medical care services, quality of care (including patient satisfaction), and health status. Some 8000 people in 2700 families are enrolled in the experiment for periods of three or five years; health status is assessed for each person on entering the experiment, annually during the experiment, and on leaving.

In the HIS, health is viewed as a multi-component concept and the definition of health provided by the World Health Organization was taken as the framework for conceptualizing child health. Following the WHO definition (19)--"health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"--three of the components identified for measurement were physical, mental, and social health. One aspect of physical health, physiologic health, was distinguished for separate measurement via a multiphasic examination (1). In addition, an integrative construct, general health perceptions, was included because it was believed to reflect all three components and to contain unique subjective information about health. A number of

constructs (specific aspects of each component) were operationally defined for measurement on the basis of those mentioned in the literature and theoretical considerations.

Although measures of the physical, mental, and social components of health status were constructed to be as independent of each other as possible, they were assumed to be significantly interrelated (3, 13, 17). Changes in physical health status due to illness might lead to changes in mental or social health. Environmental events or stress within the family might bring about changes in physical, mental, or social health or some combination of these components. Finally, changes in any health component should be reflected in parental ratings of the child's general health status. Thus, general health ratings were expected to capture a general health status factor common to all components.

To ensure that HIS measures of child health status would be most useful for their intended purpose (i.e., testing hypotheses about health care financing and health status), the following measurement goals were adhered to: (a) agreement with contemporary conceptualizations of health status components, (b) state-of-the-art questionnaire items and operational definitions, (c) use of multi-item scales and indexes to reduce the number of variables as much as possible without loss of information, (d) sufficient score variability to permit detection of actual differences in child health status in general populations, (e) sufficient reliability (i.e., the measures should be as free of error as necessary) to permit confident estimation of average health levels and group comparisons, and (f) validity, i.e., each measure should provide information about the particular health

construct it was intended to measure without duplicating other sources of data.

Unfortunately, a review of the child health measurement literature through 1973 (prior to fielding the first HIS health questionnaires) identified few health status scales developed for or applicable to children in general populations (4). Measures found in the literature were often unaggregated single items. Therefore, in many instances, construction of new multi-item scale measures of health status that would reflect the child health components of interest in the HIS was necessary.

This paper summarizes major findings of attempts to construct measures of physical, mental, and social components of health status and general health for children (ages 13 and younger). It appears to be the first attempt to assess the adequacy of a comprehensive battery of child health scales in terms of traditional measurement criteria. The studies were based on data collected at five of six HIS sites where child health was measured at enrollment. Results reported include variability of item and scale scores, estimates of reliability and validity for scales, and sociodemographic correlates of health status.

METHODS

Population Characteristics and Data-Gathering Procedures

Between fall 1975 and winter 1977, 2290 families were enrolled in five of six HIS sites: Seattle, Washington; Fitchburg/Franklin County, Massachusetts; and Charleston/Georgetown County, South Carolina.

Enrolled families differed (intentionally) from straightforward random samples of these sites in only a few respects: a) only families with heads of households 61 and younger were included; b) low income families ($9,000 and below) were slightly oversampled and no families reporting annual incomes over $25,000 (in 1973 dollars) were included; and c) people in institutions, the military, or receiving care for service-connected disabilities in Veterans Administration hospitals were excluded. Table 1 presents demographic and socioeconomic characteristics of children and families enrolled.

Questionnaires, generally completed by the mother, were used to gather data about the child's health. They were specific to two age ranges: 0-4 and 5-13 years (N's=679 and 1473, respectively). These age groupings were formed to be consistent with the beginning of school attendance for older children.

Description of HIS Measures

Physical Health. As shown in Table 2, physical health was defined in terms of functional performance and capacity with regard to specific categories of daily activities that are normal for a child in good health. The categories included self-care (e.g., bathing), physical (e.g., walking), mobility (e.g., confinement indoors), and role activities (e.g., school work). Categories were selected from those found in the children and adults' physical health literature and questionnaire items selected to represent these categories were similar to those used in previous studies of children and adults in general populations (4, 13). In addition, categories and items were reviewed by physician consultants (e.g., pediatricians) to assess

face validity and age-appropriateness of items. To reduce the influence of extraneous variables (e.g., normal maturation, interests, and personality) on questionnaire responses, almost all items included a phrase that focused on the health-relatedness of limitations. Nearly all items specified a particular category of activities and items sampled a wide range of limitations from the severe (e.g., in bed or chair most or all day) to the much less severe (e.g., limited participation in strenuous sports). One item asked about limitations (due to health) of any type. However, no attempt was made to develop a comprehensive battery. Thus, many types of limitations (e.g., those related to mental retardation and dyslexia) and fine motor abilities (e.g., handwriting) were not assessed. Limitations present for three months or less were considered acute; those of longer duration were considered chronic.

Mental Health. Mental health constructs were operationalized to emphasize psychological states (i.e., mood, feelings) rather than physiological and somatic states, or behavioral performance. HIS measures were also designed to assess both positive and negative states of psychological well-being (as reported by a proxy). Most other mental health measures used in general populations of children (e.g., 11) have focused on the identification of behavior and conduct problems (e.g., aggression, acting out, and delinquent behavior), primarily. However, HIS staff and consultants concluded that medicine is increasingly emphasizing the diagnosis and treatment of psychological problems related to symptoms of affective/mood states and anxiety disorders (e.g., depression and tension). Thus, item content used in the HIS to measure mental health emphasized the more psychologically

oriented mental health survey measures used successfully for persons 14 and older in the HIS (17) (see Table 3).

Social Relations. In the HIS, social health refers to the quality of the child's interpersonal interactions, defined in terms of getting along with significant others in the home, school, and neighborhood, as well as parental concern about these relationships (see Table 3). HIS items are similar to those fielded for children in the National Health Examination Survey (9).

General Health. General health ratings, in theory, assess both the objective information parents have about the child's health and their evaluation of that information. They were defined with respect to time (perceptions of prior and current health), and in terms of resistance or susceptibility to illness (see Table 3). Items to measure general health for children in the HIS were adapted from those originally constructed for adults by Ware and Karmos (18) and from items such as those used in the National Health Examination Survey (9).

Satisfaction With Development. This aspect of general health status was measured for younger children (ages 0-4). It was defined in terms of parental satisfaction with development in four areas: a) overall physical development; b) eating habits; c) sleeping habits; and d) bowel habits (see Table 3).

Plan of Analysis

Analyses were performed to evaluate scoring algorithms to assess the health status of children in a general population, and to examine the potential usefulness of the measures for testing

hypotheses in studies like the HIS. Specifically, data were analyzed to test the scalability of items in hypothesized groupings, internal-consistency reliability and validity of scale scores, and sociodemographic correlates of scale scores.

Scaling Physical Health Items. Based on a content analysis of published physical health items used for children and adults and empirical findings for people 14 and older in the HIS, the five functional limitations items for 0-4 year-olds and the 13 items for 5-13 year-olds were grouped into four categories: mobility, physical activity, role activity, and self-care limitations. The hypothesized order of items by dysfunction category for both age groups is given in Table 2. The number of children having limitations was too small to test these hypotheses using scalogram analysis. Rather than assume these scales, a dichotomous functional limitations score of zero (no limitations) or one (one or more limitations of any type and duration) was assigned.

Scaling Mental Health, Social Relations, General Health Peceptions, and Satisfaction with Development Items. These items were grouped according to the specific content areas they were hypothesized to measure (see Table 3). For mental health items, the three groupings (anxiety, depression, and positive well-being) were based on content analyses of mental health measures for adults in general populations and scales constructed for persons 14 and older in the HIS (17). Groupings for social relations items were based on a content analysis of published instruments used with children (4); satisfaction with development items were grouped on the strength of

their manifest content. General health rating items, the current health, prior health, and resistance/susceptibility to illness items were grouped following content analyses of similar items used for adults and empirical tests of scales for persons 18 and older in non-HIS populations (16).

A modified version of Likert's Method of Summated Ratings, multitrait scaling, and factor analysis were employed in constructing summated rating scales (16). First, using multitrait scaling procedures, matrices of item-scale correlations for each age group (e.g., 0-4) were evaluated according to the Likert-type criterion (i.e., each item had to be substantially correlated with the sum of other items in the same hypothesized grouping). Second, the criterion of discriminant validity was applied, i.e., item-scale correlations, corrected for overlap (7), were required to be substantially higher for the scale the item was hypothesized to measure than for all other scales in the matrix. When the correlation (corrected for overlap) between an item and its hypothesized scale was more than two standard errors higher than those with other scales, the item met the discriminant validity criterion. A discriminant validity scaling error was considered "definite" whenever a correlation (corrected for overlap) between an item and its hypothesized scale was two standard errors lower than a correlation between that item and another scale. Errors were considered "probable" whenever these correlations were within two standard errors of each other. Finally, using factor analysis, correlations among items were further evaluated to determine whether unhypothesized scales could be identified.

Scoring Items and Scales. Scores for each multi-item scale were computed for each child using the simple algebraic sum of scores for items that satisfied scaling criteria after recoding items, when necessary, to maintain the appropriate direction of scale scores. As a result of the methods used to select items for each scale, it was not necessary to standardize or weight items for differences in variability or the extent to which they measured the scale construct. In addition, 12 mental health items were combined (and recoded when necessary) to construct a Mental Health Index and seven general health items were combined to construct a General Health Rating Index.

Reliability of Scores. Internal-consistency reliability for each summated ratings scale was estimated using Cronbach's Alpha coefficient (2). Scale scores were considered sufficiently reliable for group comparisons when internal-consistency estimates exceeded 0.50, a recommended minimum standard for that purpose (6). In addition, because the magnitude of these estimates is, in part, a function of scale length (number of items), homogeneity estimates (i.e., average inter-item correlations) were computed for each scale. Estimates of homogeneity are useful for two reasons: 1) they indicate the extent to which scale items are reliable measures of the same construct; and 2) because they are unaffected by scale length, they facilitate comparisons between scales. In other fields, homogeneity coefficients > 0.30 have served as a standard for evaluation (16). Test-retest estimates of reliability were not obtained, to conserve measurement resources and to reduce respondent burden. Moreover, previous studies of similar multi-item scales administered to adults have indicated that internal-consistency estimates approximate test-

retest estimates of reliability across populations varying in demographic and socioeconomic characteristics (16-18).

Validity of Scores. Associations among all scales and measures of other health variables were analyzed to increase understanding of the meaning of scores and to test construct validity hypotheses. Construct validation represents an attempt to understand what a scale measures in the absence of an adequate criterion (previously validated measure of that construct). Several different approaches can be used to assess construct validity: in essence, they involve studies of the relationships between the measure of interest and other variables that should be related to a valid measure. Based on findings reported in the literature and on theoretical considerations, hypotheses regarding the strength and direction of relationships were proposed (e.g., valid measures of mental health constructs should correlate more highly with each other than with measures of physical health constructs). To the extent that empirical relationships conform to hypotheses, the construct validity of the measure and theory underlying the relationships are supported.

In addition to the measures described above, five other variables were used to study validity: 1) Presence of Chronic/Serious Illness. Included were problems that could result in moderate to severe disability (e.g., heart disease, epilepsy, chronic ear infection, asthma). Questionnaire responses were scored to determine the number of conditions (of a possible 13 for 0-4 year-olds and 18 for 5-13 year-olds) present for each child; 2) Acute Illness/Symptoms. Responses to questionnaire items were analyzed to detect problems that occurred within 30 days and resulted in mild to moderate discomfort (e.g.,

colds, earaches, diarrhea). Scores indicated the number of conditions (of a possible 15 for each age group) reported for each child; 3) Adult Health Status Ratings. Parental ratings of their own current health and overall feelings of psychological well-being (mental health) were computed for each adult rater who served as proxy respondent for the child and for each spouse or adult partner when ratings were available; 4) Pain/Distress. Degree of pain or distress experienced by the child during the past three months; and 5) Adult Worry. Degree of parental worry about the child's health during the past three months.

Several kinds of relationships, which should exist if the various scales measure what they were intended to measure, were hypothesized (see Table 4). To summarize: 1) positively defined health status scales should be positively related (e.g., Current and Prior Health); 2) negatively defined scales should be positively related (e.g., Pain/Distress and Acute Illness, or Anxiety and Depression); and 3) positively and negatively defined scales should be negatively related (e.g., Current Health and Chronic Illnesses, or Depression and Social Relations).

With respect to the relative magnitudes of associations shown in Table 4, it was hypothesized that relationships between dimensions of the same health component (e.g., anxiety and depression) would be higher than those between dimensions of different health components (e.g., anxiety and physical health). Based on the assumption that aspects of general health perceptions reflect physical, mental, and social components of health, it was expected that the general health rating scales would be significantly related

to measures of all three components. Finally, ratings of health for both parents (i.e., the proxy and the other adult) were hypothesized to be significantly related to their children's health status ratings for several reasons: genetic effects, many illnesses and environmental events (e.g., stress, death of family member) presumably affect all family members to some extent, and individuals living within the family affect each other (e.g., parental behavior affects that of the child and vice versa).

Coefficients of Association. Because the health status scales and validity variables were ordinal in nature, estimates of association computed to study construct validity were based on gamma coefficients. Gamma is sensitive to monotonic linear and nonlinear relationships for ranked data. A gamma coefficient indicates how much more probable it is to observe "like" than "unlike" order in two classifications. Whether an individual gamma coefficient was statistically significant (i.e., $p < 0.05$) varied with sample size and the probability of ties in scores (4).

Sociodemographic Correlates of Health Status. Associations between the physical health, mental health, social relations, and general health rating scores and seven demographic and socioeconomic variables were analyzed for the total sample. The demograhic and socioeconomic variables included age and sex of the child, race and education (highest grade completed) of the head of household, family income (in 1974 dollars), number of children in the family, and the birth order of the child (first/only child or later born). In the absence of agreed-upon theory, these associations were not

considered evidence of the validity of the measures but were examined to explore group differences in child health as defined by HIS measures.

RESULTS

There were very few missing responses to questionnaire items. Across sites, the percent of children for whom one or more items were missing per scale ranged from a low of 0.3% for several of the scales to a high of 6.2% for functional limitations items. Similarly, the percent of responses missing per item ranged from 0 to a high of 2.7%.

Distribution of Physical Health Item Scores

As reported in greater detail elsewhere (4), the number of children in either age group with any functional limitation(s) was small. For children 0-4 years, 96% were free of limitations, 0.6% had acute limitations only, 3.1% had chronic limitations only, and 0.3% had both acute and chronic limitations. Thus, limitations of any kind or duration were scored for only 4% of the younger children. For 5-13 year-olds, 93.9% were not limited in any way, 2.1% had acute limitations only, 3.6% had chronic limitations only, and 0.4% had both acute and chronic limitations. Thus, limitations of any kind or duration were scored for 6.1% of the older children.

Distribution of Scores for Mental, Social, General Health, and Satisfaction with Development Items

Score distributions for items in these constructs were skewed with mean values consistently on the favorable side of the item mid-point, suggesting that generally good health was reported for children in each age range (4). This pattern of results held for the combined sample and individual sites. It was judged, however, that item score variability within hypothesized item groupings was sufficient to allow tests and scoring of summated rating scales.

Construction of Summated Rating Scales

As a first step, the 12 mental health items were used to score three mental health scales (Anxiety, Depression, Positive Well-Being) and were combined into a single Mental Health Index. Those scales were tested along with five hypothesized scales constructed from items pertaining to general health, social relations, and satisfaction with development (see Table 3). All items satisfied the Likert-type criterion. Results of the discriminant validity tests for items in these scales are summarized in Table 5 and are presented in greater detail elsewhere (4). There was only one definite scaling error in 684 tests of the discriminant validity criterion (tests of the Mental Health Index, which did not produce any errors, are not included). When definite scaling errors were combined with probable errors, the number of errors ranged from a low of 12 percent (20 of 171 tests) for the combined sample to a high of 28 percent (48 of 171) for the Charleston/Georgetown sites. Thus, probable scaling errors were concentrated in two study sites.

Scales to measure Current Health, Positive Well-Being, and Social Relations tended to be error free even when judged in terms of the stringent criterion of probable errors in multitrait scaling tests. Prior health items scaled well except in Charleston/Georgetown where problems appear to have resulted from poor item reliability; i.e., the correlation between the two prior health items was low ($r = 0.25$). Other problems accounting for probable scaling errors involved difficulties in distinguishing between general health constructs (e.g., current health versus resistance/susceptibility to illness) and between mental health constructs (e.g., anxiety versus depression). With some exceptions, these problems were not site-specific. By combining the three general health rating scales into a single index and similarly, by combining the three mental health scales, nearly all of these scaling errors were eliminated. Thus, problems of item discriminant validity appear to be limited to hypothesized constructs within major components of health status.

Distribution of Scale Scores

Table 6 presents means and standard deviations for each health status scale, the Mental Health Index, and the General Health Rating Index. The goal of roughly normally distributed scale scores was not achieved for any of the scales. All scale means were on the favorable side of the midpoints of the possible scale ranges (see Table 6). Variability was sufficient, however, to test hypotheses as indicated by the standard deviations being no smaller than one-seventh of each scale range.

Reliability

Table 7 presents internal-consistency reliability estimates and homogeneity coefficients (average inter-item correlations). In the combined samples, all scale scores exceeded the standardized Alpha of 0.50 recommended for group comparisons (see the third column of Table 7). In the Charleston/Georgetown County site, reliability estimates often were substantially lower and the Resistance/Susceptibility and Prior Health scales (the only scales based on two items) did not meet minimum reliability standards. Also, the reliability estimate for Satisfaction with Development was below 0.50 in Seattle. In all sites, however, reliability coefficients for multi-item scales were substantially higher than would have been achieved with single-item measures of the same construct (4). Further, reliability estimates for the General Health and Mental Health Indexes were higher than those for the scales used to construct them.

Validity

Gamma coefficients used to study construct validity across all sites are presented in Table 8.

Associations Among the Scales. All associations were in the hypothesized direction (i.e., gamma coefficients in Table 8 were all in the direction hypothesized in Table 4). Almost all gamma coefficients were statistically significant. Several associations between scales were moderately high (above 0.40), suggesting substantial relationships. These coefficients represent estimates of associations between measures and should be interpreted as lower

bound estimates of associations between health status constructs (due to attenuation resulting from lack of perfect measurement).

Having established that associations were in the hypothesized direction, their magnitude was examined in light of hypotheses relevant to validity. As expected, the three mental health scales were highly interrelated (median gamma = 0.56) as were the three general health rating scales (median gamma = 0.37 for 5-13 and 0.34 for 0-4 year-olds).

As hypothesized, the general health rating scales were significantly related to all other scales and validity variables, except general health ratings for 0-4 year-olds did not correlate significantly with some (non-proxy) adult ratings of their own health. For older children, general health ratings correlated higher with the functional limitation measure (median gamma = 0.42) than the functional limitation measure did with either the three mental health scales (median gamma = 0.25) or the Social Relations scale (gamma = 0.19).

The median association between general health ratings and mental health scales, however, was smaller (median gamma = 0.21) than associations between the three mental health scales and social relations (median gamma = 0.39), and about the same as that between the three mental health scales and functional limitations (median gamma = 0.25). Associations between general health rating scales and the Social Relations scale (median gamma = 0.14), were about the same as the association between social relations and functional limitations (gamma = 0.19), and lower than the association between social relations and mental health (0.39). Thus, the HIS general health rating scales overlap more with physical health (i.e., functional limitations) than with mental and social health.

Because of the markedly skewed score distributions for the functional limitations measure and imperfect reliability for all measures, the estimated associations between physical health and other variables were quite attenuated. To obtain a clearer indication of differences in reported health status of children with and without any functional limitations, means for each of these groups on the other health status scales and on the acute and the chronic illness counts were compared. As shown in Table 9, functionally limited children in both age groups were reported to have significantly worse health status as measured by all scales and illness counts. Mean differences in scale scores for limited versus nonlimited children were substantial (close to one standard deviation), providing further evidence of validity for the child health scales.

Finally, parents' (proxies') ratings of their own health status were, in general, significantly associated with the rating of the child's health status. Self-ratings of health by the adult partner who did not complete the child health questionnaire, however, were less closely related to the child's reported health status. For example, proxy and older child's Current Health were more strongly associated (gamma = 0.34) than adult partner and child's Current Health ratings (0.22). Similarly, proxy and child's Mental Health were also significantly positively associated (0.23); the non-proxy adult/child association was somewhat lower (0.12). Ratings of Current and Prior Health for younger children were not significantly related to Current or Mental Health self-ratings by the adult partner.

Sociodemographic Correlates of Health Status

Relationships between the health status scales and seven demographic and socioeconomic variables for the entire sample were weak. Only three gamma coefficients reached 0.20 or above, although some were statistically significant. There were no systematic sociodemographic relationships across scales (4).

DISCUSSION

Results of the present study suggest that considerable progress has been made in developing child health measures for use in policy-oriented health services research. The scales satisfy most measurement criteria that can be evaluated adequately with cross-sectional data. For all samples (differing in age and study site) and for all health status constructs except functional limitations there was sufficient item variability to test hypothesized item groupings. However, response distributions for most items were skewed in the direction signifying good health. Except for the functional limitations items which could not be tested, items in each of the hypothesized groups were shown to measure the same primary construct. Replication of discriminant validity findings across independent samples provided support for the taxonomy of health components on which the construction of scales was based. The fact that these samples differed in educational attainment, income, and race is supportive of the generalizability of conclusions regarding the item groupings and the scales they define. However, some distinctions between health constructs (e.g., current health and resistance/susceptibility to illness) remain somewhat tenuous.

For the entire sample, mental, social, and general health rating scales were sufficiently reliable for use in making group comparisons. Reliability was lower in South Carolina, where the sample was composed of a larger proportion of disadvantaged people. The two least reliable scales (in South Carolina) contained only two items each. These two scales are more reliable than single-item measures ordinarily used in child health population surveys but they should be lengthened for use in future research.

Generally, results of studies of the interrelationships among scales and validity variables constitute good support for the multi-component model of child health and for the construct validity of HIS measures. The pattern of associations was as hypothesized, several associations were substantial, and results were consistent with the objective that each scale tends to reflect primarily one health component (e.g., mental health, social health) or multiple components (e.g., general health perceptions) as intended. Thus, when the three mental health scales are scored separately, they are more strongly associated with each other than they are to social relations or general health ratings, and when the three general health rating scales are scored separately they are substantially related to more than one component (e.g., physical health) of health status.

The value of scoring and interpreting the construct-specific mental health scales (in addition to the Mental Health Index) was demonstrated by the results of regression analyses, which are reported in detail elsewhere (4). For example, when the functional limitations variable and selected general health rating variables (e.g., Current Health, Resistance/Susceptibility) were each regressed on the Anxiety,

Depression, and Positive Well-Being scales, the most predictive mental health scale was not the same across all regressions. Therefore, how to accurately interpret the meaning of a score on an overall mental health index could not be known in advance. Consequently, if mean scores for a mental health index differ significantly across two groups, it may be due to differences in one or more mental health constructs, and scoring mental health scales separately would allow that to be determined. Thus, despite the scaling errors observed in this study that raised doubts about conceptual distinctions between mental health constructs, it appears that scaling attempts were sufficiently successful to warrant scoring Anxiety, Depression and Positive Well-Being measures separately. Finally, relationships among the mental health and general health rating scales and the other health-related variables (e.g., Chronic/Serious Illnesses) were strong enough to conclude that the scales measure health status and weak enough to indicate that construct-specific scales are likely to contribute unique information about health. In other words, it appears that these scales are not excessively redundant with each other.

These findings have special implications for child health measurement theory and for the construct validation approach to studying validity. The results provide empirical support for the utility of conceptualizing child health as a multi-dimensional state. Measures of distinct health status dimensions can be constructed for use in a general population of healthy children. The feasibility of using analyses of interrelationships of measures to assess the validity of health status measures has also been demonstrated.

There were some exceptions to the overall pattern of successful results: functional limitations scales could not be evaluated for either age group; measures of mental and social health overlapped more than was expected; some items pertaining to resistance/susceptibility to illness, current health, and mental health did not consistently correlate as hypothesized; and Resistance/Susceptibility and Prior Health scales did not meet minimum reliability standards in the site with the largest proportion of disadvantaged respondents.

Scales to measure functional limitations could not be tested because very few children had severe or mild limitations attributable to health. Previous surveys of physical impairments in general populations of children have found similarly low prevalance rates using similar questions (8, 12, 14). Thus, it is unlikely that these trends indicate a problem of measurement unique to the HIS child health battery. Rather, it is likely that only a small proportion of children in general populations experience functional limitations due to poor health status. Thus, the precision of functional limitations measures is reduced because of low prevalence of these impairments in a general population.

Large samples of children would be needed to detect treatment effects on physical health for two groups of children who are enrolled in an experiment. Using HIS enrollment data as a case-in-point, and assuming a post-test only, precision estimates of 0.05 or less for Type I errors (one-tailed test) and a power of 0.90 (a chance probability of 0.10 or less for Type II errors), 21,500 children aged 0-4 would be required to detect a small effect size (20% of the mean), 4800 to detect a medium size effect (40% of the mean), and 2100 to detect a large effect (60% of the mean). For children ages 5-13, sample sizes

somewhat smaller would be necessary: 12,400, 3100, and 1300 for 20%, 40%, and 60% of the mean, respectively. However, by assuming an intertemporal correlation of 0.50 between pre- and post-tests, a 25% reduction in required sample size could be anticipated in a design such as the one used in the HIS.

Whether the HIS social relations items are indicative of social health is open to question; they may instead be assessing a positive aspect of mental health (4). This interpretation was supported by substantial negative associations between the Social Relations scale and the Anxiety and Depression scales, and a positive relationship between Social Relations and Positive Well-Being. Although further study is required to clarify this issue, these analyses suggest either that HIS social relations items may not adequately measure the social component of child health or that mental and social components of child health are more substantially interrelated than hypothesized.

Procedural modifications, content additions, and further studies could increase reliability and validity of child health measures like those fielded in the HIS and further clarify the meaning of child health scores. First, older children may be capable of rating their own health status more validly than can proxy adults. Although no general population surveys of health using children under age 12 as the primary respondent were identified in the literature (4), there are no a priori reasons why children at least eight years old could not answer many of the questions about health presently asked of their parents. Studies of cognitive development (5) routinely obtain responses to much more complex questions than those required to assess health status from children who are well into concrete operational thought (i.e., by age eight at the latest).

Second, obtaining health status information from several qualified people (e.g., child, parent, physician, teacher) may provide a more comprehensive assessment of the child's health status than could a single source. For example, there is good evidence from the general population survey conducted on the Isle of Wight to suggest that using parents and teachers to obtain mental health and other health information is valuable for both case-finding and cross-validation (11).

Third, a more comprehensive mental health battery for use in a general population of children might include items that focus on behavior, including overt personality and conduct problems (e.g., interpersonal aggression and delinquent behavior). Again, there is precedent for combining affective and behavioral measures to define health in the Isle of Wight study (11) and several others (4). In selecting measures of mental health for the HIS, use of measures that assess overt behavioral and acting-out problems was considered but rejected because these measures were felt to be too sensitive (possibly resulting in questionnaire nonresponse) and because those problems were not considered generally treatable. Thinking has changed regarding both of these issues and a 15-item battery relating to behavior and conduct problems has been added to HIS child health questionnaires fielded after fall 1978.

Fourth, some of the HIS scales are very short and tended to fail some reliability tests in individual sites (especially South Carolina). Additional items should be added to improve their reliability prior to use by others (see 16 for sample items).

Before the HIS child health scales are used to test hypotheses about the effects of health care policies on health status, further

cross-sectional analyses and some longitudinal analyses will be performed to increase understanding of scale scores in terms of: 1) validity in relation to other information about child health status (e.g., clinical evaluations) and as predictors of health and illness behavior (e.g., consumption of medical care services); 2) changes in child health over time; and 3) response sets (e.g., socially desirable responding) that may bias scale scores.

In the HIS, several sources of information about many aspects of individual health status will be available. The validity of each child health status scale will be studied in relation to data obtained from sources other than the respondent (e.g., physician reports, laboratory reports, claims data). For example, HIS data will eventually permit analysis of the validity of mental health scores and general health ratings in relation to physician diagnoses (from claims data) for those who received care, results of comprehensive screening examinations, extent of disability reported in biweekly health diaries kept by families, and use of medical care services.

Finally, problems of response set, which have been ignored in most general population health surveys, should be addressed. Response bias may be a noteworthy problem in standardized survey measures of health (15,18). This may be especially true when parents respond for their children. Because they may wish to present their families (and thus themselves) in the best possible light, tendencies to respond in a socially desirable manner may result in children appearing more healthy than they actually are. Bias due to acquiescent and opposition response sets (tendencies to endorse or negate items regardless of content, respectively) also may be operating. The parents' own health status may

bias their perceptions and evaluations of their children's health status. The pattern of associations between adult and child health status ratings found in this study lends some plausibility to this interpretation.

In summary, although additional research must be completed to address many important measurement issues, findings thus far indicate that self-administered scales to measure child health in the HIS: 1) are applicable to general populations; 2) possess sufficient variability to allow detection of potential differences in health status; 3) are generally reliable and represent an improvement in reliability over single-item measures used currently; and 4) have validity, i.e., contain useful information about the health status constructs they were developed to measure.

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Table 1

SAMPLE CHARACTERISTICS FOR CHILDREN AGES 0-13
AND THEIR FAMILIES BY HIS SITE

Site	Children's Age	Family Income (In Dollars)	Education of Head of Family	Children's	
				Sex	Race
	Mean (SD)	Mean (SD)	Mean (SD)	% Male	% White
Seattle	6.1 (3.8)	13,344 (6112)	13.8 (2.8)	51.5	94.3
Fitchburg/ Franklin County	6.4 (3.7)	12,299 (5677)	12.4 (2.9)	52.1	97.3
Charleston/ Georgetown County	6.4 (3.9)	9,321 (6784)	10.5 (3.7)	52.7	42.6
COMBINED SAMPLE ACROSS SITES	6.3 (3.8)	11,848 (6444)	12.3 (3.4)	52.1	77.5

Table 2

FUNCTIONAL LIMITATIONS ITEMS GROUPED BY CONSTRUCT USED TO ASSESS THE PHYSICAL HEALTH OF CHILDREN AGES 0-4 AND 5-13 YEARS

Age Group	Content	Item Content
0-4	*PHYSICAL ACTIVITY*	Is this child unable to walk, unless assisted by an adult or by crutches, artificial limb, or braces?
	ROLE ACTIVITY	Does health limit this child in any way from doing anything he or she wants to do?
		Does this child's health limit the kind or amount of ordinary play he or she can do?
		Does this child's health keep him or her from taking part in ordinary play?
	SELF-CARE ACTIVITY	Because of health, does this child need more help than usual for a child this age in eating, dressing, bathing, or using the toilet?
5-13	*MOBILITY*	Does this child's health limit him or her in any way in using public transportation or a bicycle?
		Does this child need help in getting around the neighborhood because of health?
		Does this child have to stay indoors most or all of the day because of health?
		Is this child in bed or a chair for most or all of the day because of health?
	PHYSICAL ACTIVITY	Does this child's health limit the kind or amount of vigorous activities he or she can do, such as running, lifting heavy objects or taking part in strenuous sports?
		Does this child have trouble bending, lifting, or stooping because of health?
		Does this child have trouble either walking several blocks or climbing a few flights of stairs because of health?
		Because of health, does this child have trouble either walking one block or climbing one flight of stairs?
		Is this child unable to walk unless assisted by an adult or by a cane, crutches, artificial limb, or braces?
	ROLE ACTIVITY	Does health limit this child in any way (from doing anything he or she wants to do)?
		Is this child unable to do certain kinds or amounts of schoolwork because of health?
		Does this child's health keep him or her from going to school?
	SELF-CARE ACTIVITY	Because of health, does this child need help with eating, dressing, bathing, or using the toilet?

Table 3

ITEMS AND HYPOTHESIZED ITEM GROUPINGS USED TO MEASURE MENTAL HEALTH, SOCIAL HEALTH, GENERAL HEALTH PERCEPTIONS, AND SATISFACTION WITH DEVELOPMENT CHILDREN AGES 0-4 AND 5-13 YEARS

Construct	Item Groupings	Items and Response Categories
MENTAL HEALTH	Anxiety	How much of the time during the past month did this child seem to: o feel relaxed and free of tension?[a] o be able to relax without difficulty?[a] o be bothered by nervousness or "nerves?"[b] o be anxious or worried?[b] o be restless, fidgety or impatient?[b]
	Depression	How much of the time during the past month did this child seem to: o feel lonely?[a] o be depressed (downhearted or blue)?[a] o be moody or to brood about things?[a]
	Positive Well-Being	During the past month how much of the time did this child: o generally seem to enjoy the things he or she did?[a] o seem to wake up feeling fresh and rested?[a] o seem to be cheerful and lighthearted?[a] o seem to be a happy person?[a]
SOCIAL HEALTH	Social Relations	During the past three months how well has this child gotten along with: o other children?[b] o the family?[b] o teacher and classmates?[b] During the past three months how much have you been worried or concerned about this child's problems in getting along with others?
GENERAL HEALTH PERCEPTIONS	Current Health	This child's health is excellent.[c] This child seems to be less healthy than other children I know.[c] In general, would you say this child's health is excellent, good, fair or poor?[d]
	Resistance/Susceptibility	This child seems to resist illness very well.[c] When there is something going around, this child usually catches it.[c]
	Prior Health	This child was so sick once I thought he or she might die.[c] This child has never been seriously ill.[c]
DEVELOPMENTAL MILESTONES	Satisfaction with Development	How do you feel about this child's: o growth/development?[f] o eating habits?[f] o sleeping habits?[f] o bowel habits?[f]

[a] Response categories were based on the frequency of the event.

[b] Response categories were based on a rating of the degree of intensity of the problem.

[c] Response categories were: definitely true, mostly true, don't know, mostly false, definitely false.

[d] Response categories were: excellent, good, fair, poor.

[e] Response categories were: a great deal, some, a little, none at all.

[f] Response categories for all items were: very satisfied, somewhat satisfied, neither satisfied nor worried, somewhat worried, very worried.

Table 4

HYPOTHESIZED DIRECTION OF ASSOCIATION BETWEEN HEALTH STATUS SCALES AND VALIDITY VARIABLES

Scales/Validity Variables	Direction of Scoring[a]	Scales/Validity Variables																
		CH	RS	PH	P	A	D	PWB	SR	DS	CI	AI	FL	AWS	AW	ACH	AMH	OACH	OAMH
Current Health (CH)	+																		
Resistance/Susceptibility (RS)	+	+																	
Prior Health (PH)	+	+	+																
Pain/Distress (P)	-	-	-	-															
Anxiety (A)[b]	-	-	-	-	+														
Depression (D)[b]	-	-	-	-	+	+													
Positive Well-Being (PWB)[b]	+	+	+	+	-	-	-												
Social Relations (SR)[b]	+	+	+	+	-	-	-	+											
Satisfaction with Development (DS)[c]	+	+	+	+	-	-	-	+	+										
Chronic/Serious Illnesses (CI)	-	-	-	-	+	+	+	-	-	-									
Acute Illness/Symptoms (AI)	-	-	-	-	+	+	+	-	-	-	+								
Functional Limitations (FL)	-	-	-	-	+	+	+	-	-	-	+	+							
Adult Worry Re: Social Relations (AWS)[b]	-	-	-	-	+	+	+	-	-	-	+	+	+						
Adult Worry (AW)[d]	-	-	-	-	+	+	+	-	-	-	+	+	+	+					
Adult Current Health (ACH)[e]	+	+	+	+	-	-	-	+	+	+	-	-	-	-	-				
Adult Mental Health (AMH)[e]	+	+	+	+	-	-	-	+	+	+	-	-	-	-	-	+			
Other Adult Current Health (OACH)[f]	+	+	+	+	-	-	-	+	+	+	-	-	-	-	-	+	+		
Other Adult Mental Health (OAMH)[f]	+	+	+	+	-	-	-	+	+	+	-	-	-	-	-	+	+	+	

[a] Signs reflect the direction of scoring (e.g., a (+) indicates that a high scale score reflects favorable health while a (-) indicates that a high scale score reflects unfavorable health).

[b] Scales for children ages 5-13 only.

[c] Scale for children ages 0-4 only.

[d] Degree of parental (proxy's) worry about the child's health.

[e] Proxies' ratings of their own current health and overall feelings of psychological well-being.

[f] Ratings by spouse or adult partner (of the proxy) of their own current health and overall feelings of psychological well-being.

Table 5

SUMMARY OF DISCRIMINANT VALIDITY RESULTS FOR NINE HEALTH STATUS SCALES, COMBINED SAMPLE AND THREE SITES, CHILDREN AGES 0-4 AND 5-13 YEARS

Scales	Number of Items	Combined Sample (N=679; 1,473)[a]	Seattle (N=300; 604)	Fitchburg/ Franklin County (N=149; 371)	Charleston/ Georgetown County (N=229; 493)
Current Health	3[b]	26/27[c]	25/27	25/27	25/27
Resistance/Susceptibility	2[b]	14/18	15/18	13/18	4/18
Prior Health	2[b]	17/18	18/18	13/18	8/18
Anxiety	5[d]	23/30	19/30	24/30	19/30
Depression	3[d]	14/18	13/18	12/18	12/18
Positive Well-Being	4[d]	21/24	19/24	20/24	20/24
Mental Health Index	12[d]	48/48[f]	48/48[f]	48/48[f]	47/48[f]
Social Relations	4[d]	24/24	24/24	24/24	24/24
Satisfaction with Development	4[e]	11/12	5/12	7/12	11/12
TOTALS ACROSS SCALES		150/171	137/171	138/171	123/171

[a] Ages 0-4 and 5-13, respectively.

[b] Ages 0-4 and 5-13 combined for analyses.

[c] Read table as follows: 26 out of 27 times the item met the discriminant validity criterion.

[d] Ages 5-13 only.

[e] Ages 0-4 only.

[f] Not included in totals across scales.

Table 6

MEANS AND STANDARD DEVIATIONS (IN PARENTHESES) FOR HEALTH STATUS SCALES, COMBINED SAMPLE AND THREE SITES, CHILDREN AGES 0-4 AND 5-13

Scale [a]	Number of Items	Score Range		Midpoint of Range [b]	Combined Sample (N=679; 1,473) [c]	Site		
		Possible	Observed			Seattle (N=300; 604)	Fitchburg/ Franklin County (N=149; 371)	Charleston/ Georgetown County (N=229; 493)
AGES 0-4								
Current Health	3	3-14	3-14	8.5	12.28 (1.90)	12.31 (1.91)	12.77 (1.79)	11.91 (1.89)
Resistance/Susceptibility	2	2-10	2-10	6.0	7.46 (1.79)	7.36 (1.82)	7.48 (1.75)	7.58 (1.77)
Prior Health	2	2-10	2-10	6.0	8.12 (2.33)	8.10 (2.42)	8.12 (2.27)	8.14 (2.25)
General Health Rating Index	7	7-34	7-34	20.5	27.87 (4.59)	27.78 (4.63)	28.38 (4.84)	27.66 (4.35)
Satisfaction with Development	4	4-20	7-20	12.0	18.30 (2.01)	18.31 (1.85)	18.54 (1.87)	18.13 (2.28)
AGES 5-13								
Current Health	3	3-14	3-14	8.5	12.29 (1.82)	12.50 (1.64)	12.70 (1.73)	11.73 (1.94)
Resistance/Susceptibility	2	2-10	2-10	6.0	7.93 (1.69)	7.99 (1.61)	7.96 (1.70)	7.82 (1.79)
Prior Health	2	2-10	2-10	6.0	8.15 (2.36)	8.14 (2.45)	8.24 (2.39)	8.10 (2.22)
General Health Rating Index	7	7-34	11-34	20.5	28.38 (4.46)	28.65 (4.38)	28.91 (4.46)	27.65 (4.48)
Anxiety	5	5-30	5-30	17.5	9.17 (3.42)	9.45 (3.39)	8.96 (3.24)	8.99 (3.56)
Depression	3	3-18	3-14	10.5	5.14 (1.90)	5.30 (1.85)	5.04 (1.75)	5.03 (2.05)
Positive Well-Being	4	4-24	4-24	14.0	19.80 (2.75)	19.53 (2.64)	20.03 (2.33)	19.95 (3.13)
Mental Health Index	12	12-72	21-72	42.0	61.46 (7.06)	60.76 (7.04)	62.02 (6.48)	61.90 (7.42)
Social Relations	4	4-19	5-19	11.5	16.22 (2.40)	15.84 (2.46)	16.22 (2.31)	16.69 (2.31)

[a] Scale is scored in the direction of its name (i.e., high score = good current health, etc.

[b] Midpoint of possible scale range.

[c] Ages 0-4 and 5-13 respectively.

Table 7

RELIABILITY ESTIMATES FOR HEALTH STATUS SCALES,
COMBINED SAMPLE AND THREE SITES, CHILDREN AGES 0-4 AND 5-13

Scale	Number of Items	Reliability[a]							
		All Sites Combined		Seattle		Fitchburg/ Franklin County		Charleston/ Georgetown County	
		r_{ii}	r_{tt}	r_{ii}	r_{tt}	r_{ii}	r_{tt}	r_{ii}	r_{tt}
AGES 0-4									
Current Health	3	.50	.75	.57	.80	.61	.82	.36	.63
Resistance/Susceptibility	2	.42	.59	.52	.68	.50	.66	.28	.44[b]
Prior Health	2	.36	.53	.44	.61	.39	.56	.25	.40[b]
General Health Rating Index	7	.32	.77	.35	.79	.46	.85	.24	.68
Satisfaction with Development	4	.23	.54	.17	.44[b]	.26	.58	.28	.61
AGES 5-13									
Current Health	3	.44	.70	.44	.70	.47	.73	.38	.65
Resistance/Susceptibility	2	.43	.60	.59	.74	.51	.68	.27	.43[b]
Prior Health	2	.40	.57	.48	.65	.48	.65	.23	.38[b]
General Health Rating Index	7	.32	.76	.35	.79	.35	.79	.26	.72
Anxiety	4	.34	.72	.39	.76	.45	.80	.24	.62
Depression	5	.43	.69	.48	.74	.44	.71	.37	.63
Positive Well-Being	4	.45	.77	.49	.79	.51	.80	.40	.73
Mental Health Index	12	.35	.87	.41	.89	.41	.89	.28	.83
Social Relations	4	.51	.81	.55	.83	.51	.81	.44	.76

[a] r_{ii} = the average inter-item correlation (homogeneity of the items);

r_{tt} = the internal-consistency reliability (standardized Alpha) of a score computed by the formula

$$\frac{kr_{ii}}{1 + (k-1)r_{ii}}$$

where k equals the number of items used to compute the score.

[b] Internal-consistency reliability probably too low to detect small group differences.

Table 8

GAMMA ASSOCIATIONS[a] AMONG HEALTH STATUS SCALES
AND VALIDITY VARIABLES FOR CHILDREN AGES 0-4 (UPPER TRIANGLE)
AND CHILDREN AGES 5-13 (LOWER TRIANGLE)

Scale	CH	RS	PH	P	GHI	A	D	PWB	MHI	SR	DS	FL	CI	AI	AW	ACH	AMH	OACH	OAMH
Current Health (CH)		47[b]	34	-42	c						28	-56	-34	-30	-48	24	17	14	*18*
Resistance/Susceptibility (RS)	55		34	-32	c						19	-36	-27	-26	-30	*11*	*10*	*07*	*00*
Prior Health (PH)	37	32		-31	c						16	-52	-33	-24	-26	16	13	*07*	*04*
Pain/Distress (P)	-52	-41	-26		-39						-28	67	39	45	74	*-13*	*-11*	*-13*	*-13*
General Health Rating Index (GHI)	c	c	c	-43							22	-59	-35	-30	-38	19	14	*10*	*08*
Anxiety (A)	-24	-21	-13	30	-20														
Depression (D)	-23	-20	-13	33	-19	56													
Positive Well-Being (PWB)	29	24	17	-30	24	-58	-56												
Mental Health Index (MHI)	27	23	15	-32	22	c	c	c											
Social Relations (SR)	16	14	11	-25	14	-36	-39	40	40										
Satisfaction with Development (DS)												-48	-24	-29	-33	17	17	*11*	*10*
Functional Limitations (FL)	-56	-41	-42	68	-53	38	24	-25	-32	-19			70	38	63	-26	*-10*	-24	-29
Chronic/Serious Illness (CI)	-34	-28	-24	41	-32	19	19	-17	-18	*-08*	52			31	36	*-09*	-14	*-05*	*-05*
Acute Illness/Symptoms (AI)	-28	-30	-16	49	-26	22	28	-24	-26	-14	34	29			37	-18	-18	*-13*	*-11*
Adult Worry (AW)[d]	-60	-41	-30	85	-48	30	28	-29	-30	-20	72	43	40			-16	-22	*-12*	*-11*
Adult Current Health (ACH)[e]	34	21	14	-19	24	-16	-16	16	16	13	-23	-11	-14	-21			31	20	*09*
Adult Mental Health (AMH)[e]	20	14	09	*-10*	15	-20	-21	23	23	21	-11	-11	*-09*	-14	36			17	23
Other Adult Current Health (OACH)[f]	22	14	09	-14	16	*-05*	*-08*	*08*	*06*	*07*	-12	*-10*	*-10*	-17	25	17			35
Other Adult Mental Health (OAMH)[f]	16	11	*08*	-16	14	-10	-11	15	12	11	-19	*-08*	-12	-17	14	28	35		

[a] All coefficients except those in italics are significant at $p < .05$.

[b] Decimals have been omitted.

[c] Associations were not computed between components of the index and the overall index.

[d] Degree of parental (proxy's) worry about the child's health.

[e] Proxies' ratings of their own current health and overall feelings of psychological well-being.

[f] Ratings by spouse or adult partner (of the proxy) of their own current health and overall feelings of psychological well-being.

Table 9

HEALTH STATUS SCALE MEANS AND STANDARD DEVIATIONS (IN PARENTHESES) FOR CHILDREN WITH AND WITHOUT FUNCTIONAL LIMITATIONS

Scale	Limitations: None[a]	Limitations: One or more[b]	t-Test Value
AGES 0-4			
Current Health	12.38 (1.79)	10.15 (2.84)	6.15**
Prior Health	8.21 (2.28)	6.15 (2.76)	4.57**
Resistance/Susceptibility	7.52 (1.76)	6.44 (2.12)	3.09**
General Health Rating Index	28.12 (4.40)	22.74 (6.02)	6.12**
Satisfaction with Development	18.38 (1.87)	16.15 (3.50)	5.81**
Acute Illness/Symptoms	1.72 (1.46)	2.74 (1.87)	3.53**
Chronic/Serious Illness	0.33 (0.59)	1.07 (0.92)	6.19**
AGES 5-13			
Current Health	12.42 (1.68)	10.42 (2.51)	10.54**
Prior Health	8.26 (2.31)	6.79 (2.66)	5.77**
Resistance/Susceptibility	8.00 (1.64)	6.86 (2.07)	6.24**
General Health Rating Index	28.69 (4.23)	24.07 (5.41)	9.80**
Anxiety	8.98 (3.23)	11.58 (4.70)	7.13**
Depression	5.09 (1.86)	5.83 (2.16)	3.60**
Positive Well-Being	19.88 (2.65)	18.61 (3.46)	4.32**
Mental Health Index	61.82 (6.75)	57.19 (9.07)	6.11**
Social Relations	16.28 (2.31)	15.14 (3.48)	4.24**
Acute Illness Symptoms	1.34 (1.39)	2.09 (1.70)	4.82**
Chronic/Serious Illness	0.37 (0.63)	0.89 (0.93)	7.18**

[a] N = 644 for children ages 0-4; N = 1,365 for children ages 5-13.

[b] N = 27 for children ages 0-4; N = 89 for children ages 5-13.

** $p < .01$.